1.0 System Test Plan

1.1 Unit Testing

The R2000's UI and exoskeleton will be rigorously tested before integration, ensuring that the inputs and outputs will match correctly. Upon integration of the sub-modules, the following tests will be conducted upon the completed R2000 exoskeleton system.

1.2 Calibration Testing

Calibration mode will be used to verify the system is responding properly prior to use:

1. UI prompts user to push one of the five buttons on keypad. User presses the corresponding keypad, and the UI displays a verified message. The UI repeats this five times for the other keys.
2. UI prompts user to turn the rotary encoder. User will move the encoder all the way around, while the UI displays the corresponding angle. UI displays a verified message.
3. UI prompts user to toggle the emergency switch to the on position. User toggles the emergency switch to the on position. UI displays a verified message, and prompts the user to move the emergency switch to the off position. UI again displays a verified message.
4. UI cycles the red and yellow LED on and off.
5. Exoskeleton moves from 0° to 30°, 0° to 60°, then 0° to 90° to ensure angular limitations.
6. Calibration mode is complete.

1.3 Normal Case 1: User goes through entire exercise

In the case where conditions are normal and the user is comfortable to carry out the entire routine:

1. UI confirms the user's desired range of motion, in degrees, number of repetitions, and sets.
2. UI gives a visual countdown when the exoskeleton begins.
3. Exoskeleton lifts the user's shank to the desired angle.
4. Exoskeleton repeats the exercise to the desired number of repetitions.
5. Exoskeleton returns to the neutral position.
6. UI waits 15 seconds, and gives a visual countdown, to avoid overheating the servo.
7. User performs next set, and returns to Step 3.
8. User either shuts off system or enters new data if exercise is complete.

1.4 Normal Case 2: User must stop exercise

In the case where conditions are normal, but the user is uncomfortable in carrying out the rest of the exercise (starting from point three from Normal Case 1):

1. User feels discomfort and switches the emergency switch to the active position.
2. UI gives visual feedback that emergency switch has been activated and cancels any remaining repetitions.

3. Exoskeleton returns to the neutral position.
4. User either shuts off system or enters new exercise data.

1.5 Normal Case 3: Battery runs low

In the case where conditions are normal, but the battery life has reached a critical level (starting from point three in Normal Case 1):

1. Microcontroller detects battery life is below 25% and notifies user via LCD screen.
2. Microcontroller detects battery life is at 5% if the user continues use of the R2000.
3. UI notifies user that their exercise will now end due to low power and cancels any remaining repetitions.
4. Exoskeleton returns to the neutral position.
5. R2000 shuts down and the user must switch the UI interface off.

1.6 Extreme Case 1: Potential Servo Overheating

In the case where conditions are abnormal and the servo starts drawing too much current (starting from point three in Normal Case 1):

1. Microcontroller detects servo is continuously drawing 3.0A or more while lifting shank.
2. UI notifies user that the load is too heavy for the R2000 to lift.
3. UI notifies the user that the exercise will now end and cancels any remaining repetitions.
4. R2000 shuts down and the user must exit the R2000.